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ABSTRACT

A pilot project designed to improve the cognitive education program for 24 hearing impaired undergraduate preprofessionals incorporated aspects of instrumental enrichment (IE), an approach to enhance cognitive skills at the representational level. Ss participated in paper-and-pencil cognitive activities aimed at improving five skills: projection of virtual relationships, orientation in space, comparison, analytic perception, and following precise instructions. Activities were followed by discussions of how to apply the skills to instruction with children. Results, based on the Wilcoxon matched-pairs, signed-ranks test for differences between pre- and post-testing, indicated no significant pre-post differences between experimental and control groups on a Self-Rating Scale, on the Uncritical Inference Test (Haney, 1976), on a Picture Completion Test (adapted from the Gestalt Completion Test of the Kit of Factor-Referenced Tests, 1976), on a specially designed Comparison Test, or on a 15-item Learning Style Indicator. However, trends among the experimental group showed movement toward improved ability to carry out comparisons, toward seeing oneself as more systematic in approaching work-study situations, and toward reflectivity and a preference for a visual modality. Among conclusions are that college-age hearing impaired students are capable of improving cognitive function and that the integration of supplemental cognitive interaction activities of a content-free nature is feasible at the college level. (CL)

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# ENHANCING COGNITIVE PERFORMANCE IN THE HEARING-IMPAIRED COLLEGE STUDENT: A PILOT STUDY

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## Abstract

Pre-service teacher education has focused for decades on foundations courses and methods courses, but at no point has any systematic attention been given to improving the cognitive functioning of pre-service teachers. The result has been teachers who have often been unsystematic in their approaches to problem-solving situations in their professional work, as well as frequently unable to predict, classify, analyze, and synthesize in a precise and logical way--all of which are cognitive skills. In addition, now a clear trend is emerging in school curriculum to teach children such cognitive strategies, and teachers require special training in order to properly carry out cognitive education for their students.

For certain hearing-impaired young adults, this problem is exacerbated because of the experiential and linguistic deficits which often characterize the background of profoundly deaf children of hearing parents.

Results of pilot research with hearing-impaired pre-service teachers at Gallaudet College are presented, indicating that (a) cognitive modification is indeed possible for the hearing-impaired young adult, (b) systematic intervention in the context of existing college curricula is an effective form of intervention, and (c) college faculty training in cognitive education is an essential prerequisite for effective intervention for the hearing-impaired teacher trainee.

Thus, a fully developed cognitive education program for hearing-impaired pre-professionals has two objectives: (a) to significantly improve the intellectual functioning of hearing-impaired teachers as adults, thus enabling them to employ the above-mentioned skills to the systematic planning and implementation of all of their professional responsibilities, and (b) to fully prepare them to be teachers of cognitive skills to the hearing-impaired children in their own classrooms.

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## Rationale

The need for systematic instruction of students in cognitive strategies is clear in view of national test results indicating a decline in problem-solving skills. In addition, with the nation in an apparent "back-to-basics" fad in curriculum which tends to focus on lower-level thinking skills, direct action by instructors is essential immediately in order to maintain a balance in the curriculum. However, the availability of specific programs designed to meet this need in the college setting has indeed been limited. More specifically, instructors who work with hearing-impaired college students at Gallaudet College frequently express deep concern and frustration about some of their students' serious deficiency in problem-solving skills, as indicated in both classroom and written work. The concern often relates to difficulty with manipulating more than one variable, conceptualizing what a textbook or journal author is saying, forming conclusions, dealing with hypothetical data, and spatial reasoning.

Yet, research with hearing-impaired persons has documented that no basic malfunctions are present in the cognitive abilities of that general population and that any inferiorities in cognitive performance may be able to be accounted for by experiential and linguistic deficits and by communication handicaps (Levine, 1976, 28). To compound the problem, many instructors themselves have had little or no formal training in operational thinking, either as part of their own training or as a subject for teaching (Passow, 1980, 399).

## Review of the Literature

It is useful to divide the review of the relevant literature into three related bodies: research on the cognitive development of the college-age student in general, research on cognitive development in hearing-impaired learners in general, and research on cognitive performance of hearing-impaired college-age students.

A. Cognitive Development of the College-age Student

Prior work in the investigation of cognitive development of the college-age student has occurred on a limited scale. The seminal work of Perry (1968; 1981) identified nine levels of cognitive behavior which are characteristic of the college-age student (without attention to any specific handicap such as hearing impairment).

In papers presented at the 1983 Conference of the American Educational Research Association, it was indicated that at least 30% of college students are operating below the "formal" level in Piagetian terms (Taylor, 1983). Research has also indicated that the greatest cognitive change occurs during the first two years of college (Mentkowski, 1983). Research on cognitive instruction of college-age students in analogical reasoning indicates dramatic improvement as the result of instruction, although similar effects were not found in regard to syllogistic reasoning (Piantkowski, 1983). Thus, it would appear that the optimum time for the needed intervention in cognitive development should occur during the freshman and/or sophomore years of college.

A considerable body of related work has taken place on the cognitive development of the pre-service teacher, i.e., that college student who is enrolled in a teacher-training program. While that literature may be of limited relevance to an intervention that cuts across career interests of a hearing-impaired college-age population, some specific findings illuminate the present investigation. Renner (1975) reported positive growth in Education Majors at the college level as the result of specific training in methods of teaching science using highly-structured reasoning activities. Schenkat and Battaglini (1980) established a clear case for teaching future teachers some specific reasoning skills as a means of helping them to organize their instruction of children. Gil (1980) found that beginning teachers lacked specific strategies for gathering information and for diagnosing

children's needs. Beginning teachers (just graduated from college) have been frequently found to be lacking in their ability to plan and organize according to their supervisors; thus, the cognitive performance of the college-age student is indeed a ripe subject for improvement.

B. Cognitive Development of the Hearing-Impaired Learner

Studies in cognition in relation to hearing-impaired persons have also been numerous in recent years. After an initial period of focusing on I.Q., the center of attention now is on the processes involved in cognition and perception. It appears to be generally accepted that hearing-impaired persons have the normal range of intelligence when tested on the performance, rather than the verbal, subtests of various I.Q. instruments (Drever & Collins, 1928), with the exception of students who have neurological impairments resulting from an etiology of hearing loss that has multiple effects (Vernon, 1968, 8). In a more detailed examination of hearing-impaired subjects by specific etiology of loss, however, some differentiation in performance is also found; for example, the mean I.Q. for "genetically deaf" students was reported to be 114, while that for postmaternal rubella deaf students was 95 (Vernon, 1968, 7). When the influence of age is controlled statistical data on hearing-impaired children indicate strong relationships between achievement test scores and variables such as age of onset of hearing loss, cause of loss, degree of loss, additional handicapping conditions, ethnic background, and type of special educational program (Jensema, 1975). Thus, there appears to be a rationale for examining the effects of a new intervention program within identified etiological sub-groups.

The relationship between language and cognition is both essential and complex; this study focuses on an intervention program which makes regular use of language as a medium. For example, using language enables the learner to restructure mental schemata, perceive reality in new ways, and to redesign the

strategies employed to solve problems (Klein, 1981, 449). A major body of research during the past 50 years indicates that language in social interaction is critical to effective cognitive development (Vygotsky, 1962, 1978; Wertsch, 1978). The work of Halliday (1973) and Tough (1977) has reinforced Vygotsky's work and given new insights into the degree of linguistic use by children in attacking cognitive problems. Thus, it is highly appropriate that an intervention program for hearing-impaired children in the area of cognitive development should recognize and use language in a systematic manner since, as previously noted, the linguistic deficits of hearing-impaired children are considered to be partly responsible for some of their difficulties in cognition.

C. Cognitive Performance of the Hearing-Impaired College-age Student

A few specific investigations have taken place in the area of reading skills in the hearing-impaired adult. Deaf adult readers, for example, have been found to employ an internal structure or organization that is consistent with that used by hearing students; however, the particular "clusters" into which deaf students sort sentences within a story appear to be organized differently than for hearing students (Knight & Yekovich, 1982). Networking is a technique in which the reader identifies the relationships among concepts in prose passages as a learning strategy; Long, et al. (1982) found that for deaf college students networking has a greater impact on their long-term retention of prose than on their immediate test performance. In addition, networking has a greater impact when students write out their networks than when they network material "in their heads" (Long, et al., 1982).

The literature on the improvement of cognitive skills in the college-age learner strongly supports the efficacy of separate training in those skills. Even minimal training in cognitive strategies has resulted in long-term effects (Dansereau, et al., 1975). Weinstein (1977) found that the more successful

learners use meaningful elaboration strategies, albeit often covertly. Hence, the merits of specific training in these skills is supported (Weinstein, et al., 1980). In addition, training per se was found to be superior to merely giving simple instructions (Weinstein, et al., 1981).

Thus, the literature establishes a clear need for interventions to improve the cognitive performance of hearing-impaired learners of college-age, yet indicates relatively little evidence of prior efforts to carry out such interventions systematically.

## Program Description

### A. The Program

Considerable interest is now being expressed in improving thinking skills in the classroom setting. One writer has called for classroom teachers of hearing-impaired students to develop their own programs and explains some guidelines for so doing (Cole, 1980, 344). Furth, after drawing conclusions from research on the need of hearing-impaired students for practice in thinking and reasoning, followed through with a book on "thinking games" based on Piagetian task and theory (Furth & Wachs, 1974). Other existing school programs such as the Peninsula Oral School approach have focused on sequences of cognitive strategies or tasks for hearing-impaired students, leading through concept formation, interpretation, inference, generalization, and application of principles (Levine, 1976, 54). With such clearly expressed need and interest, an already-formulated program which is thoroughly tested would seem most timely and would not necessitate teachers having to develop their "own" products.

Such a program is Instrumental Enrichment, developed originally in Israel by Reuven Feuerstein, a student of Piaget, in response to the need for mediated learning experiences (MLE) for culturally disadvantaged groups emigrating to

Israel. Feuerstein developed the program known as Instrumental Enrichment (IE), a three-year supplement to the regular curriculum in which students focus on paper-and-pencil exercises of increasing complexity designed to develop and enhance fourteen specific cognitive skills at the representational level of thinking, such as categorization, comparison, logic, and sequencing.

Instrumental Enrichment provides an excellent mechanism in relation to the results of studies cited earlier for the following reasons:

1. It uses a "metacognition" approach in that students are given repeated opportunities to reflect on their own thinking processes.

2. Unlike those cognitive training programs focusing on impulsivity as a personality characteristic, IE assumes that impulsivity is a characteristic of the "retarded performer" due to his lack of adequate mediated learning experience; thus, IE assumes that impulsivity may be reduced or eliminated, but for a different reason than other programs.

3. IE definitely develops the prerequisites for learning and does not assume that those prerequisites already exist in the learner.

4. IE recognizes the age-specificity of developing generalizable cognitive strategies: Feuerstein is unambiguous about the IE program being appropriate only for learners at the representational level of thinking and beyond.

5. IE does not assume that generalization will automatically occur; rather, a critical element in the daily instructional sequence for IE is the "bridging" exercises in which the teacher overtly and actively promotes transfer by the student of skills to both real-life and curricular situations.

Thus, the IE program represents a highly logical step in the history of cognitive intervention programs.

B. Prior Research Results

The results of using the IE program with hearing students are positive. In an experiment in Toronto using two groups of high school students, with one group using the IE program and the other not, the mean subtest scores on the Stanford Achievement Test for the IE group were higher in reading comprehension, mathematical computation, mathematical application, spelling, and language (Narrol,

1978, 49). In addition, a significant mean increase in the number of correct answers on the Lorge-Thorndike Intelligence Test from pre- to post-test was found for the IE group (35.8 vs. 51.44).

IE is used extensively in the Israeli Army to ensure that inductees acquire appropriate skills, and studies have been conducted in that country; follow-up studies of IE groups indicate that statistically significant structural changes in the cognitive processes of subjects as measured by psychometric tests actually increased over a period of two years after students completed the program (Feuerstein & Jensen, 1980, 422).

To date, IE has been used on a limited basis with hearing-impaired student populations. Pilot experiments with the Instrumental Enrichment program with hearing-impaired adolescents at the Model Secondary School for the Deaf (Gallaudet College) has indicated that as a result of this kind of intervention, hearing-impaired students improve measurably in the skills of reading comprehension, mathematical computation, systematic approach to problem-solving, organization of solutions to subject-matter problems, and abstract thinking (Martin, 1983).

## Design

Twenty-four hearing-impaired undergraduate junior-year students in a Gallaudet College Curriculum Foundations course and an Educational Psychology course constituted the experimental subjects of this pilot study in the spring of 1983.[1] The instructors of both courses, one of whom was the author, had been previously trained in-depth (during a twelve full-day period) in the methods and materials of the Instrumental Enrichment program. A control group of ten students in a parallel Educational Psychology course at the same institution took the same

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[1] The author acknowledges the valuable cooperation and assistance of Anna Hauptman, Ph.D. in the design, implementation, and analysis of this pilot study.

measures at the end of the semester for purposes of comparison with the twenty-four students in the experimental group. All experimental and control subjects were undergraduate education majors.

At the beginning of each course, each experimental subject took the Uncritical Inference Test (Haney, 1967); a Picture Completion Test which was made up of 10 visual closure items adapted from the Gestalt Completion Test from the Kit of Factor-Referenced Tests (1976); a Learning Style Indicator which consisted of 15 items to which the student responded in regard to his or her learning style (5 items related to visual/spatial versus verbal modality preference, 5 items related to field-dependence versus field-independence, and 5 items related to impulsivity versus reflectivity); a Self-Rating Scale, consisting of 10 questions with which the student checked degree of agreement in regard to general study habits; and a specially developed test of Comparisons in which the student had to examine two four-frame storyboard illustrations and answer questions requiring the identification of similarities and differences within each storyboard and between the two storyboards. At the end of each course, each subject again took all tests.

For experimental subjects, paper-and-pencil cognitive activities were included in alternate class sessions throughout the semester for forty-five minutes on each occasion for a period of 15 weeks. The activities were drawn from five "instruments" related to improving the specific skills of: a) projection of virtual relationships, b) orientation in space, c) comparison, d) analytic perception, and f) following precise instructions. Each activity was followed by a discussion for insight into how that particular skill could be applied to: a) teaching children the same skill, b) the other subject matter of the course itself, c) professional teaching behaviors such as lesson-planning and materials-

selection, and d) life or "outside world" functioning such as finding a job and selecting a mate.[2]

## Results

### A. Curriculum and Educational Psychology Groups (Spring 1983)

On the Uncritical Inference Test (Haney, 1967), for the Spring 1983 groups in Curriculum and Educational Psychology, no significant differences were found between the Experimental and Control groups at the end of the experimental period.

Results on the Comparisons Test were content-analyzed by independent judges for precision, detail, and relevancy of the similarities and differences described, and scores were assigned on that basis to each subject's test. While the Wilcoxon matched-pairs signed-ranks test for differences between pre and post testing for the experimental group produced no statistically significant differences, a clear trend was found in the data on the post test showing improvement in experimental subjects' abilities to: state similarities, state differences, be precise in description, and explain the meaning behind pictorial stimuli. A rank test for two independent samples was used to test the significance of difference between the Experimental Group and the Control Group on the Comparisons Test at the end of the semester. A "z" score of 2.71 was found, which was significant beyond the .01 level, favoring the Experimental group.

On the Self-Rating Scale, responses were weighted to favor a "true" response in regard to each of ten desirable work habit traits. Again, the Wilcoxon Test

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[2] In addition, a supplemental pilot study during the fall semester of 1983 is applying activities from the same five cognitive skill areas on a weekly basis in undergraduate courses in the liberal arts with Gallaudet College freshmen and sophomores, involving a total of 60 students in the departments of English, Sociology, Government, and Communication Arts. Finally, another 25 students in the English program in the Gallaudet College Preparatory Studies Program (a special pre-freshman year program) are using the same instruments during the same time period. Results of this added study are expected to be available in 1984.

indicated no significant differences between pre and post testing for the Experimental Group. However, trends indicated that the experimental subjects increased in their self-reported tendency to: follow directions, carry out course work carefully, correct their own mistakes, and take the time to think through an answer before writing it on paper. A rank test for difference between two independent samples produced no significant statistical differences between groups; again, however, trends favoring the experimental group on the same four traits were noted by inspection of the response groupings within each item for both groups.

Responses to the Picture Completion Test were summed across items for each experimental subject, and submitted to the Wilcoxon Test for differences between pre and post testing. No statistically significant difference was found between administrations, and no clear trends were discernible between pre and post testing. No statistically significant difference was found between Experimental and Control Groups.

Results on the Learning Style Indicator were analyzed through summing Control and Experimental group responses for preferred modality, and then contrasting pre and post tests within groups using the Wilcoxon Rank Test. No statistically significant differences were found within groups; no differences were found on the field dependence/independence items for the Experimental group; however, a clear trend with the Experimental group was noted toward preference for a visual versus a verbal modality, and toward preference for reflectivity versus impulsivity. The rank test for difference between independent samples was used to contrast Experimental and Control Groups on these two latter dimensions; a "z" score of 2.59 was found (significant beyond the .01 level), favoring the experimental group. Table 1 summarizes the comparisons between Experimental and Control groups on these other four measures.

Table 1

Differences Between Experimental and Control Groups on Four Measures of Cognitive Functioning (Curriculum and Educational Psychology Classes)

| Test | Rank Test of Difference z Score | p |
|---|---|---|
| Comparisons (identify similarities and differences, precision, explanation) | 2.71 | $< .01$ |
| Self-Rating Scale of Work Habits | 1.37 | Non-significant |
| Picture Completion Test | .97 | Non-significant |
| Learning Style Indicator (Movement toward reflectivity and visual preference) | 2.59 | $< .01$ |
| Experimental | N = 24 | |
| Control | N = 10 | |

## Discussion

The specialized nature of the population of hearing-impaired students and the rather small and non-random sample sizes admittedly contributed to the limitations of this pilot study. While no statistically significant differences were found between pre and post administrations of these measures for the Experimental Group in the Educational Psychology and Curriculum classes, clear trends were observed in three out of the four measures, showing movement toward improved ability to carry out comparisons and its associated skills, movement toward seeing oneself as more systematic in approaching work-study situations, and movement toward reflectivity and preference for a visual modality. In addition, statistically significant differences were found between Experimental and Control Groups, in regard to quality of Comparisons, and in Learning Style preferences on the criteria mentioned.

The lack of either significant difference or trend difference on the Picture Completion Test may relate to the fact that all subjects use a visual mode of communication on a daily basis (sign language) and are therefore already dependent on a strength in the area of visual closure; thus, a short-term intervention of the type described would not produce notable differences since subjects were already operating at a relatively high level in this skill.

The self-perceived improvement within the Experimental Group in taking the time to think through a problem on the Self-Rating Scale and the clear trend toward reflectivity on the Learning Style Indicator validate each other well, and would be evidence that the intervention succeeded in reducing impulsivity. The clear trends favoring greater precision and improved abilities to accurately describe similarities and differences would attest to the success of even a brief 15-week intervention in promoting those generic cognitive skills.

The paradoxical movement on the Learning Style Indicator by the Experimental Group toward a visual preference requires some additional comment. Because IE uses many problem-solving materials which are visually-oriented, Experimental subjects were led to use this mode which was relatively unused prior to the intervention. One would <u>expect</u> hearing-impaired persons such as these particular teacher trainees, who use sign language, to be highly accustomed to operating in a visual modality; however, prior research has suggested that the processing of that language modality by a hearing-impaired person is at the symbolic and <u>not</u> at the pictorial level, just as is also true for a hearing person. Thus, this cognitive intervention shows promise of assisting the adult hearing-impaired learner to make use of a previously unused modality in the process of problem-solving, to balance the already-developed verbal modality.

## Conclusions

From this pilot study, the following conclusions are drawn:

1. The college-age hearing-impaired population is indeed amenable to observable and measurable gain in cognitive functioning level.

2. The integration of supplemental cognitive interaction activities of a content-free nature is feasible in the context of the subject matter in at least preprofessional studies at the college level.

3. Specific faculty development is necessary to train instructors in the methodology of such an intervention.

4. Additional larger-scale research is now required with more varied and larger samples of hearing-impaired students of college age in additional subject matter contexts to validate, replicate, and enlarge upon the findings of the present pilot study. (Such an investigation is currently underway, as mentioned in Note 2).

The potential for improvement in cognitive performance of the hearing-impaired learner as late as the college level is clearly suggested by this study. The involvement of such populations at campuses other than Gallaudet will now be welcomed by the investigator for the next phases of the study.

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